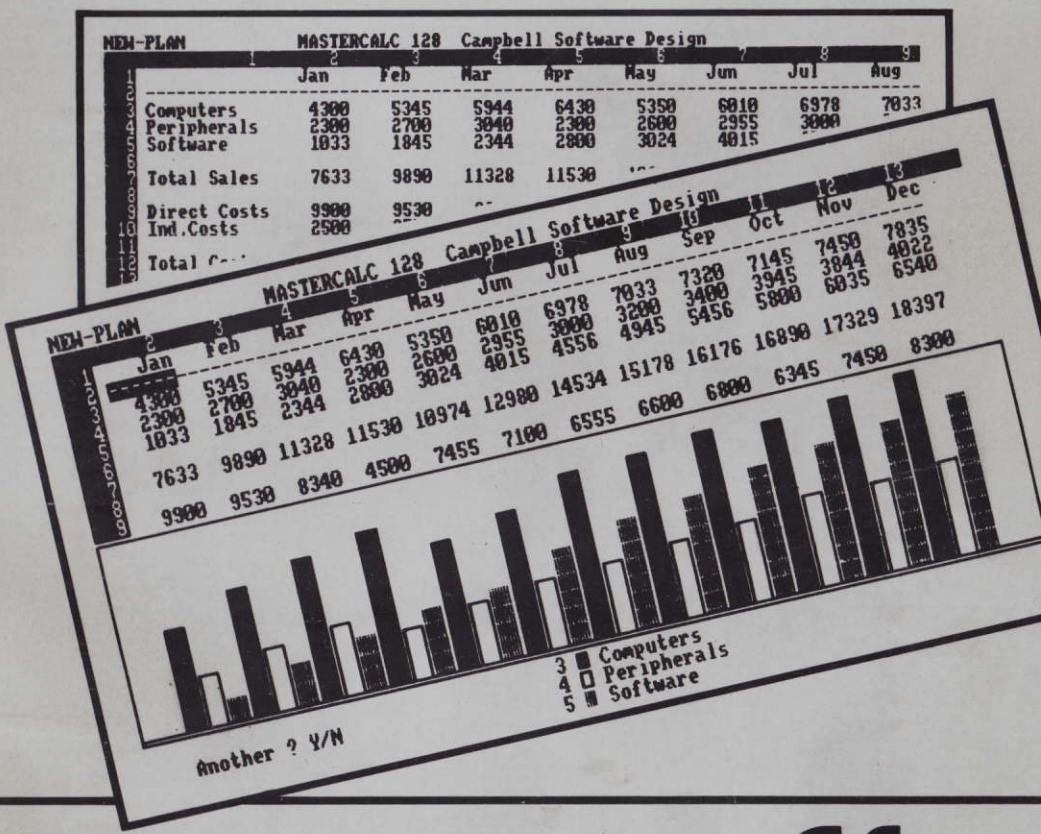
MASTERCALC 128

Spread-Sheet Program

FOR AMSTRAD 128K CPC 6128

(Also extended 128K CPC 464/664)



Campbell Systems CS

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NOTICES

a) Addenda

Please note that any additions/corrections to this manual, together with any version-dependant POKE adaptations, will be documented on the distribution disc. Access to these will be as prompted after:

RUN"DISC" [ENTER]

b) Copyright

MASTERCALC 128 has been developed by and is the sole copyright of:

Campbell Systems
57 Trap's Hill
Loughton
Essex IG10 1TD Tel: 01-508 5058

It is unlawful to pass any copy of program or manual to a third party without the written permission of the copyright holder.

c) Disclaimer

Whilst every effort has been made to ensure that the program performs correctly and accurately, we cannot accept liability for any direct or consequential loss arising from the use of this software.

d) Compatibility

MASTERCALC 128 is fully compatible with the earlier 64K MASTERCALC and is capable of loading files created by that earlier version.

WHAT IS A SPREAD-SHEET?

A spread-sheet is a piece of paper on which numerical information is written in order to help one see what is happening to a business or process. It is divided into rows across and columns down and often includes totals and other values computed from the entered data.

A financial balance sheet is a kind of spread-sheet. So is a bank statement, and so is a sales performance chart. Many spread-sheets show time-related figures, each column of figures being associated with a particular week or month or year.

Spread-sheets are usually annotated with headings and other pieces of text, especially to label the rows and columns.

The problem with paper spread-sheets is that they are prone to human error in calculations, and any amendments involve tedious re-work.

An electronic spread-sheet such as MASTERCALC 128 lets the computer do all the tedious arithmetic work. Indeed, so easy is it to re-work data on the computer, the electronic method is used today in ways where manual plans were seldom used; in simulation, planning, projections. The more usable spread-sheet systems also allow the numbers to be converted into graphic charts for even better visual impact.

Financial models especially benefit from spread-sheet treatment, since the computational aspects of inflation accounting, discounted cash flow, fluctuating exchange rates, are handled with ease.

SOME CONCEPTS INTRODUCED

The electronic spread-sheet has just one disadvantage compared with the sheet of paper: the computer screen cannot show the entire sheet except for the smallest of plans. But this does not limit the program capacity, since the screen is used as a "window" through

which to view any part of the whole plan. And what started as a disadvantage becomes an advantage, since the computer can handle a plan rather larger than would be practical on a single piece of paper.

In order to "navigate" around a plan, a co-ordinate system is used, just as one finds with maps. Thus every row and column is given a number, and each "cell" is uniquely identified by its row and column number. For the purpose of moving our window and for relating information, we use this numbering system. With MASTERCALC 128, the top left corner of the plan is row 1 column 1.

Our program shows row numbers down the left side of the screen, and column numbers across the top, in reversed colours.

The intersection of a row and column is called a CELL and each cell can hold a number between 0 and 9999999999999999 (+ or –). Alternatively, a cell can hold text. With MASTERCALC, any cell can be used for either purpose.

Within the window, the currently-accessed cell is highlighted using reversed colours which we call the cell CURSOR. Thus, before entering information, the cursor is positioned over the target cell.

Numbers may be computed rather than simply entered. Computations are effected either by using one of the TOTAL functions, or by defining a FORMULA. A formula specifies some numerical relationship between cells, for example showing one cell as the percentage of two other cells.

MASTERCALC offers flexibility in the way numbers are displayed, in that they can be integer or up to seven decimal places, with optional thousands commas. All numbers are computed and held to the highest precision and displayed rounded to match the number of decimal places required.

Unlike many inferior systems, MASTERCALC lets you choose the display style individually per column, and also the display width of any column can be set between 4 and 24 characters. Thus extra room can be set for labels and row totals. Further, column widths and formats can be altered at any time without loss of data or precision.

Spread-sheets (sometimes we call them "plans") can of course be saved to disc (or tape) and re-loaded on demand at any time.

SUMMARY OF MASTERCALC 128 FEATURES

** Large capacity, room for 7,000 cells, e.g. 200 rows x 35 columns.
** All values stored as signed 8-byte floating point.
** Direct totals and sub-totals by row or by column.
** Up to 99 formulae, each allowing complex arithmetic expressions.
** Unique formula portability allowing many cells to share a formula.
** Formulae can have conditional terms.
** Recalculate by row or by column.
** Insert or erase a row or column.
** Text can be keyed directly anywhere on a plan.
** Text in a cell can be "nudged" left or right.
** Numbers can be shown as integer or up to 7 decimal places.
** Numbers can include 000's commas.
** Columns can be tailored individually in respect of width/format
** Numeric display range is +/– 0.0000001 to 9,999,999,999,999,999
** Intermediate computation range is approx 10 to the power +/– 38.
** Plan can be "folded" to keep distant columns in simultaneous view.
** Screen can be split horizontally into two independent windows.
** Toggle between 40-column and 80-column mode.
** Auto-cursor advance right or down.
** Repeat-last-value facility.
** Text print with many printer options.
** Text output to disc, for word-processing for example.
** Hi-res screen snapshot for Epson-compatible printers.
** Instant highlight of all computed cells.
** Graphic histogram of 1, 2 or 3 row variables.
** Colour trim.
** Pop-up menu of the main options.
** Load/save/drive select/CAT options.
** User BASIC option for specialist use.
** Fully machine coded, with fast memory bank-switching.

CONVENTIONS

In the text you can take "MASTERCALC" to mean "MASTERCALC 128". The terms "PLAN" and "SPREADSHEET" are synonymous.

When MASTERCALC offers a menu or prompt message it will respond equally to keys in lower case or upper case. However, in this manual we describe all menu responses in upper case for clarity. Thus when we say press "R", you may press "R" or "r".

Where we use square brackets, we mean "the key marked with this word". Thus [ENTER] means "the ENTER key". Note that [CTRL K] means "the CONTROL key held down then K key pressed".

[CTRL] is equivalent to [CONTROL]. [ENTER] and [RETURN] keys have the same effect unless the user chooses to redefine one or other of these keys.

Apart from the top menu, concerned primarily with starting and terminating a session, MASTERCALC communicates through prompts shown near the bottom of the screen. There is also a "pop-up" menu showing the main display options; this is a memory jogger only, and need not be displayed in order to summon those options. The prompts are of two kinds: those which require text terminated by [ENTER], and those which respond immediately to a single key.

Where text is required, a cursor blob is offered and your response can be edited as you go.

Single-key responses are either Y/N — waiting for the Y or N key — or they offer a list of words from which you choose by pressing the first letter of the chosen word. For example, the following prompt responds to S or F:

Sub-total/Full total

Where a single-key response is awaited, no cursor blob is offered. In most cases, there is an implicit [ESC] option to "back out", which means you have changed your mind. In some cases [ENTER] is also a "back-out", but can also mean "take default action". Sometimes any unprompted key is taken as a back-out, where we thought it more friendly.

LOADING MASTERCALC 128

It is generally wise to perform a full reset [CTRL/SHIFT/ESC] before loading a program if the computer is still switched on after another job has run. If any RSX (e.g. RS232 driver) is required, load and initialise it before loading MASTERCALC.

First-time use should be initiated with:

RUN "DISC" [ENTER]

This will give you the option to view any possible documentation changes, and will offer a simple self-explanatory menu.

To load the program more directly:

RUN "MC128" [ENTER]

MC128.BAS is the name of the default loader. You may have other loaders under different names, especially if you are making use of the USER BASIC functions.

The loader program then loads the machine code components (suffixed by .BIN) which in turn produce the top menu and the program is then ready for use.

The next chapter is a detailed tutorial which introduces many, but not all, MASTERCALC functions. All users should take the trouble to work through this tutorial.

MASTERCALC TUTORIAL – INTRODUCTION

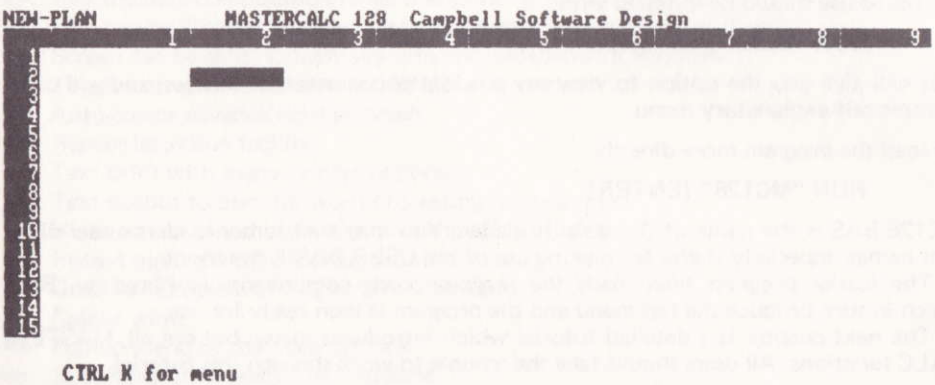
In this tutorial we build a modest spread-sheet to analyse the profitability of a hypothetical computer dealer. We will tabulate monthly sales by three product areas, and expenses by two types. The aim is to show the monthly and cumulative profitability – or lack of it.

We will show time horizontally – as is customary – and each column will show one month's data. For 12 months we need 12 columns; but we also need a column for labels and a year total column, making 14 in all. For rows we need two for headings, five for sales and expenses, two total lines, a computed profit line, and few extra for grouping, say 15 in all. We can always insert extra rows or columns later if we need to.

Starting up

Reset the computer and: **RUN "MC128" [ENTER]**

Press N to start a New plan. Give the dimensions as prompted: Rows = 15, columns = 14. The empty spread-sheet is then displayed as in fig. 1. All rows are shown, but columns 10 onwards are for now not visible.



[figure 1]

Try the steering wheel

Use the four cursor arrow keys – singly – to steer the cell cursor around the window. Notice that column 1 is wider than the rest.

Now try [SHIFT] with right-arrow and see how the window alters to show the remaining columns, although column 1 remains in view. [SHIFT] with left-arrow restores the original window view.

Note that [SHIFT] with up/down arrow does not move the window since with our small plan all rows are already contained.

Thus cursor arrow keys alone steer the cursor within the window, whilst with [SHIFT] they steer the window. There are more cursor/window functions for you to explore later, but already we have described all those needed for this tutorial.

A quick look at the controls

Near the bottom of the screen you will see "CTRL K for menu". This is a reminder that a "pop-up" menu of display options is available just by pressing [CTRL K]. Try it now – this is faster than reaching for the manual! Now use [ENTER] to resume our still-empty plan. Now press [CTRL S] to see how many spare bytes there are; of course there is a vast amount of unused RAM with this small plan.

Headings

We will put month headings along the top, as follows. First steer the window to the left-most position if needed, then steer the cursor to row 1 column 2. Now press [SHIFT 2], i.e. double quote symbol key. This tells MASTERCALC that we wish to enter text and you will see the acknowledgement: "Enter text at the cursor" at the bottom of the screen. Now, anything you key will be written into the cursor cell. You will be keying spaces which are hard to show here, so we use a dot to mean the space bar key:

. . . Jan . . . . . Feb . . . . . Mar . . . . . Apr . . . . . May . . . . . Jun . . . . . Jul . . . . . Aug

Then use [ENTER] to signal end of text, whereupon the "Enter text . ." prompt will vanish. Note that we were able to enter text into several cells in a continuous manner. But we must break to shift the window before we can continue the text into column 10 etc. Shift the window to the right then use [SHIFT 2] and enter the remaining months:

. . . Sep . . . . . Oct . . . . . Nov . . . . . Dec . . . . Year [ENTER]

Now to put dashes throughout row 2 to underline the headings. Press L to take the cursor to the left of the window, then down-arrow to move the cursor to row 2 column 10. Now [SHIFT 2] then hold down the minus-sign key [–] until the window edge stops it, then [ENTER]. Move the window back to the start position and the cursor to row 2 column 1. Fill row 2 with dashes as before, pressing [ENTER] when the right edge of the window is reached.

If you make a mistake during text entry, [DEL] is a destructive back-space but only within the current cell. You can always re-enter text over an individual cell. You can also "nudge" text left or right within a cell using < or >. (These are the less-than and greater-than symbols, not cursor arrows.) Steer the cursor to row 1 column 2 and shuffle the word "Jan" back and forth to see how this works.

That completes the column headings, so now for the row labels; steer the cursor to row 3 column 1.

Press [CTRL D] which should cause a down-arrow to appear in the bottom left corner of the screen. This symbol reminds that we turned on the "auto-cursor-advance" which means that the cursor advances to the next cell after entering text or data. This was not necessary for text going across, but we will see it helps with text entered cell by cell downwards.

Now for the text: Press [SHIFT 2] and enter the heading:

Computers [ENTER]

The cursor will drop to row 4 automatically. Now [SHIFT 2] and:

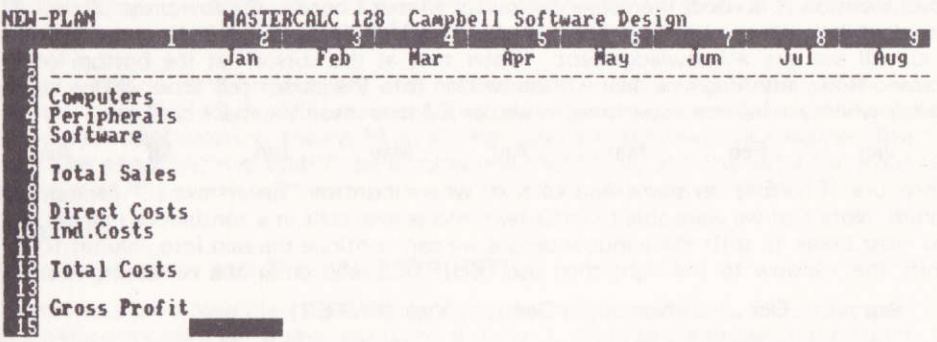
Peripherals [ENTER]
[SHIFT 2]
Software [ENTER]

[ENTER] again to skip a row. When auto-advance is toggled on, [ENTER] acts as if the right or down arrow has been pressed.

Then in row 7: [SHIFT 2] and

Total Sales [ENTER]

In like fashion, enter heading "Direct Costs" in row 9, "Ind. Costs" in row 10, "Total costs" in row 12, "Gross Profit" in row 14. Your plan should now look like fig. 2:



[figure 2]

Any slips?

If you make any slips such as forgetting to prefix text with [SHIFT 2] you may accidentally invoke other functions, or even enter values. Do not panic, you will not cause undue damage.

If, for example, you intend to enter "Computers" but forget the [SHIFT 2] then command C invites "Give column number". Just back out with [ESC] and try again. Likewise, "Software" begins with S so if you forget the opening [SHIFT 2] the screen S- plits into two windows; just press S a second time to revert to single window.

If you press [CTRL] then let go when pressing [2], you will find you have started entering a numeric value beginning with 2. Back out with [ESC] if you have not yet pressed [ENTER].

If you hit a "conflicting data" message when trying to re-write a cell, you will need to press [ENTER] then [CTRL Z] then E to clear the cell before you can rebuild its contents.

Entering the primary data

Steer the cursor to row 3 column 2 (Computer sales for January) and press [CTRL R] to make the auto-advance arrow at lower left of the screen point to the right. If this was already indicated, then you just toggled it off – so repeat until the arrow appears again. Now press the 4 key. Immediately the prompt appears:

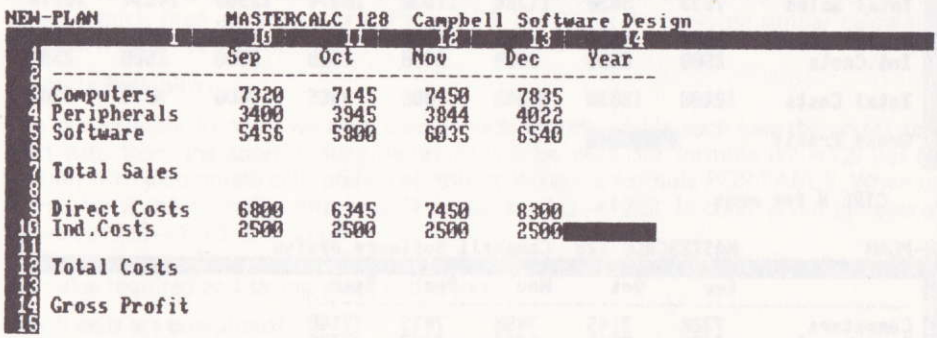
Value: 4

MASTERCALC takes any numeric or sign or dot key to be the start of numeric data to be entered at the current cell. But unlike text, the keyed data is echoed in the prompt area.

Finish the value being entered by keying: 300 [ENTER]. The value 4300 is then stored and shown at the current cell, and the prompt vanishes.

The cursor will have advanced to column 3 ready for you to enter the February sales figure. Invent and store computer sales figures all the way to column 9 (August). Use just four-digit numbers for now. You can shift the window right and complete the figures up to December but it may be easier to enter the rest of the data in the current window first. Choose how you wish to do it, but one way or another enter more invented figures into rows 4, 5 and 9 from Jan to Dec.

Row 10 is "Indirect Costs" and often in business these are more or less constant. We will pretend this is so for our plan. Enter 2500 at row 10 column 2. Ensure the auto-advance-right is set (Use [CTRL R] if required). Now hold down [SHIFT 6] and watch as the last entered value is rapidly repeated across the window. Shift the window then enter 2500 at row 10 column 10 then repeat the [SHIFT 6] treatment all the way to column 13. Your plan should resemble fig. 3.



[figure 3]

Column Totals

You have now entered all the "raw" data and now we will ask MASTERCALC to do some real work by computing some totals. Place the cursor at row 7 column 2 (Total Sales for January) and press T which yields:

TOTAL: Row/Column/Accum

Press C to indicate we are totalling vertically. Then you are asked:

Sub-total/Full total

Either will give the same answer in this situation but the most logical choice is Sub-total so press S. Immediately the three values in rows 3, 4, 5 are totalled into the cursor cell. The cursor advances (because auto-advance is still on) so you can repeat the sequence TCS TCS etc all across the window to produce more monthly totals.

Now move the cursor to row 12 column 2 (Total Costs for January) and again use a series of TCS responses to generate the sub-totals of monthly costs.

Reposition the window to access the remaining months and repeat the treatment up to December.

Row Totals

So far column 14 should be empty from row 3 downwards. We will now ask the program to compute the "Year" totals by row. Take the cursor to row 3 column 14. Toggle auto-advance downward using [CTRL D]. We want a Total by Row, Full, so press: TRF.

The row total is computed and stored immediately and the cursor will advance down one row so now press TRF TRF to build row 4 and row 5 totals. Press [ENTER] to skip row 6, then TRF for row 7. Likewise use TRF in rows 9, 10, 12 and 14. Your plan should resemble fig. 4.

```
NEW-PLAN          MASTERCALC 128  Campbell Software Design
          1        2        3        4        5        6        7        8        9
 1                Jan      Feb      Mar      Apr      May      Jun      Jul      Aug
 2  ----------------------------------------------------------------------------------
 3  Computers     4300     5345     5944     6430     5350     6010     6978     7033
 4  Peripherals   2300     2700     3040     2300     2600     2955     3000     3200
 5  Software      1033     1845     2344     2800     3024     4015     4556     4945
 6
 7  Total Sales   7633     9890    11328    11530    10974    12980    14534    15178
 8
 9  Direct Costs  9900     9530     8340     4500     7455     7100     6555     6600
10  Ind.Costs     2500     2500     2500     2500     2500     2500     2500     2500
11
12  Total Costs   12400    12030    10840    7000     9955     9600     9055     9100
13
14  Gross Profit           ■■■■■■■■
15
```

```
↓   CTRL K for menu
```

```
NEW-PLAN          MASTERCALC 128  Campbell Software Design
          1       10       11       12       13       14
 1                Sep      Oct      Nov      Dec      Year
 2  ----------------------------------------------------------
 3  Computers     7320     7145     7450     7835     77140
 4  Peripherals   3400     3945     3844     4022     37306
 5  Software      5456     5800     6035     6540     48393
 6
 7  Total Sales   16176    16890    17329    18397    162839
 8
 9  Direct Costs  6800     6345     7450     8300     88875
10  Ind.Costs     2500     2500     2500     2500     30000
11
12  Total Costs   9300     8845     9950     10800    118875
13
14  Gross Profit■■■■■■■■
```

You key: **r7–r12 [ENTER] [ENTER]**

The formula is now stored but not yet used. Steer the cursor to row 14 column 2, set auto-advance-right, and press F. You are then asked:

Formula number 1–99:

Press 1 [ENTER]. Immediately, the profit for January is computed and stored at the cursor, which then advances right. Repeat F1 [ENTER] to generate similar calculations for each month, up to December.

Formula Portability

The same simple formula we have used in each month, and in each case the computation used data from the appropriate column. This is because our formula (r7–r12) has been written with incomplete cell references, thus making the formula PORTABLE. When used in column 2 the formula behaves as if coded as r7c2–r12c2. In column 3 it behaves as if coded as r7c3–r12c3, and so on.

Wherever possible, use portable terms in your formulae, thus reducing the number of formulae required and saving space and effort.

Which cells are computed?

This can be useful to know, especially where there are many such cells. To see which cells in the window are computed, press [CTRL T]. Try it. Each computed cell is high-lighted with a short legend showing how it was computed. For example, rows 7 and 12 will show "CST" meaning "Column sub total". Column 14 shows "RT" meaning "Row (full) total". And row 14 shows "FO1" meaning "Computed using formula no. 1". Press any key to clear the high-lights.

Re-calculate

So far, row 14 column 14 shows zero, since row 14 had no values at the time we specified a total here. To make MASTERCALC recompute all totals and formula usages, press [CTRL C]. Do so now, and you will see very briefly the legend:

– – – Calculating – – –

Then the window is updated showing any changes. Try altering some of the base data, e.g. sales of software in May, then use [CTRL C] again and note the changes.

If necessary, put some high Indirect costs here and there to force some negative profits (i.e. losses).

Squeeze

It may be important to be able to see all 12 months together in one window – and we can do this at any time. Columns 2 onwards started at 8 characters wide. Let us reduce them to 6 as follows. Use [CTRL A]:

ALTER: array size Y/N

[CTRL A] is a "blanket" control to perform many format changes, but since we are not about to insert or erase rows or columns, reply to the above with N. Another menu is offered:

Width/Dec pl/Commas/Title

We are going to change column widths, so press W. Then:

From column . . . :

Reply 2 [ENTER], then:

. . . To column:

Reply 13 [ENTER], then:

Width (4–24)

Reply 6 [ENTER]. The dialogue has ended (at last!) and the window is redrawn with columns 2–13 shown only 6 characters wide. This has caused no loss of data.

Press L then O (letter Oh) then 2 [ENTER]. Now you will see that all twelve months can fit in the window, and your plan should look like fig. 5.

NEW-PLAN MASTERCALC 128 Campbell Software Design

	2	3	4	5	6	7	8	9	10	11	12	13
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	------	------	------	------	------	------	------	------	------	------	------	------
3	4300	5345	5944	6430	5350	6010	6978	7033	7320	7145	7450	7835
4	2300	2700	3040	2300	2600	2955	3000	3200	3400	3945	3844	4022
5	1033	1845	2344	2800	3024	4015	4556	4945	5456	5800	6035	6540
6												
7	7633	9890	11328	11530	10974	12980	14534	15178	16176	16890	17329	18397
8												
9	9900	9530	8340	4500	7455	7100	6555	6600	6800	6345	7450	8300
10	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500	2500
11												
12	12400	12030	10840	7000	9955	9600	9055	9100	9300	8845	9950	10800
13												
14	-4767	-2140	488	4530	1019	3380	5479	6078	6876	8045	7379	7597
15												

→ CTRL K for menu

[figure 5]

A Picture is worth ...

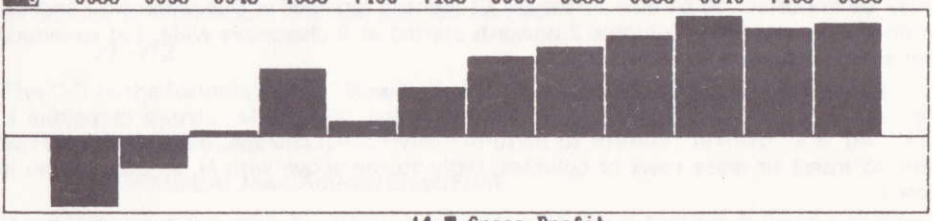
With columns 2–13 in view, press [CTRL G]. You are then asked:

Give 1st row to plot:

Reply 14 [ENTER] [ENTER]. The lower half of the screen shows a histogram of gross profit in each month. Negative values (did you have any?) are shown as downward bars. See fig. 6.

NEW-PLAN MASTERCALC 128 Campbell Software Design

	2	3	4	5	6	7	8	9	10	11	12	13
1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
2	------	------	------	------	------	------	------	------	------	------	------	------
3	4300	5345	5944	6430	5350	6010	6978	7033	7320	7145	7450	7835
4	2300	2700	3040	2300	2600	2955	3000	3200	3400	3945	3844	4022
5	1033	1845	2344	2800	3024	4015	4556	4945	5456	5800	6035	6540
6												
7	7633	9890	11328	11530	10974	12980	14534	15178	16176	16890	17329	18397
8												
9	9900	9530	8340	4500	7455	7100	6555	6600	6800	6345	7450	8300

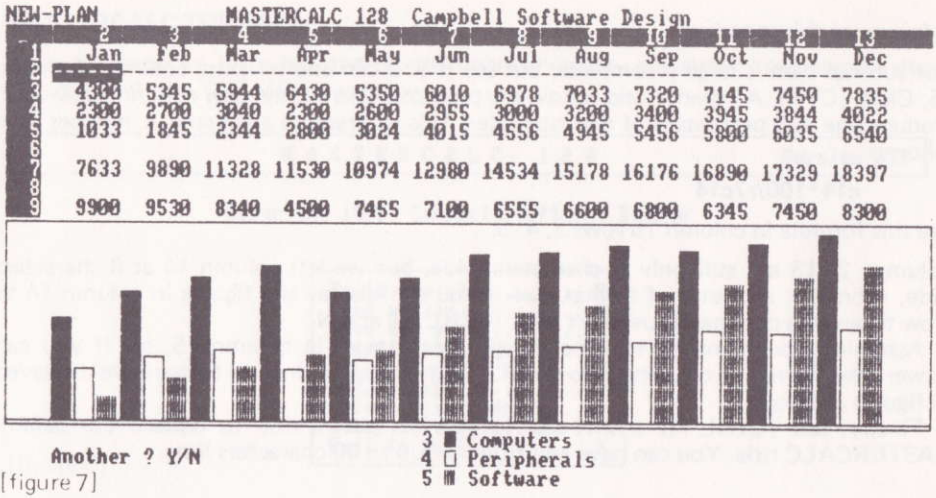


Another ? Y/N 14 ■ Gross Profit

[figure 6]

Another ? Y/N

Now press Y to indicate another chart, and this time reply to the "rows to plot" prompts with 3 [ENTER] 4 [ENTER] 5 [ENTER]. This then plots the relative sales of the three product lines. See fig. 7.



[figure 7]

If you have an Epson-compatible printer attached, then a graphic copy of the screen can be achieved using [CTRL 0]. (CONTROL and zero.) Try it. There may be a moment's pause before the printer responds, so be patient. Hi-res printing takes rather longer than text printing.

Experiment by charting other row numbers. Terminate the session by replying N in response to: Another ? Y/N.

Text output

With any printer attached, text output should be possible. If you have already made a hi-res screen copy then first turn your printer off then on, to reset the line feed rate.

Use [CTRL H] to reset the window to the top left of the plan, then initiate the text operation with [CTRL P]. A prompt appears:

TEXT: Printer/Disc

Reply with P, because we will send text to the printer rather than to the disc. The next prompt is:

Row/column numbers to show Y/N

Press Y for now. More prompts will appear, but for now just reply to them all with [ENTER] to assume default actions. After the last prompt, printing of the plan will take place. The full width of the plan will not appear since the default printer width of 80 is too narrow. MASTERCALC starts printing the plan where the window is, so by shifting the window and printing again, the remaining sections can be handled.

Saving the plan for later

To save the plan on disc for use in a later session, first exit to the top menu using [CTRL X]. Press S and you are asked:

Give file name:

With a formatted disc in place, enter a name of up to eight characters and press [ENTER] whereupon the save is made. On completion, the main plan display is resumed, and the file name appears at top left of the screen.

A few more things to try

Our tutorial plan is largely complete; but see if you can add an extra column – number 15. Clue: [CTRL A] then Y and follow the prompts. Then in the new column, show each product line as a percentage of the total sales. This will require a formula, e. number 2, as follows:

c14*100/r7c14

Use this formula in column 15 rows 3, 4, 5.

Columns 2–13 are still only 6 characters wide, but we left column 14 at 8 characters wide, room for a change of format. See if you can display the figures in column 14 to show thousands commas. Clue: start with [CTRL A] and N.

Assuming you managed to generate the percentages in column 15, see if you can convert the format of column 15 to show 2 decimal places, since so far we have displayed all figures as integer.

Finally, use [CTRL A] and N etc. to give the plan a title to replace the default MASTERCALC title. You can have any title text up to 40 characters long.

MASTERCALC TOP MENU

When the program is loaded, the program name, version, and other headings are shown, together with the TOP MENU as below:

```
M A S T E R C A L C   1 2 8                    Version 2.2

Copyright 1985 Campbell Software Design

Build new plan.....N
Load a plan.....L
Save the plan.....S
Display catalogue.....C
Resume current plan....R
Select tape.....T
Select disc / drive....D
Alter colours.....*
Exit to BASIC.....X
```

[figure 8]

To select one of these, press the indicated key. However, options R and S will not respond until a plan has been started or loaded. The options are now described.

N: Build New Plan

This is used to initiate a new plan. (If a plan is already in RAM, you must confirm its erasure via Y as prompted.) You are asked:

How many rows:

Reply with a number between 5 and 230. Next, you are asked:

How many columns:

Again, reply in the range 5 to 230.

The maximum number of cells is around 7,200 so clearly a 230 x 230 plan is not possible. Over-size yields the message:

Dimension error – ENTER

Given valid dimensions, the program displays the new empty plan ready to receive data. But probably your first task will be to tailor the column widths and formats.

L: Load a Plan

The alternative way to start a session is to load a plan saved at an earlier session. You are prompted thus:

Give file name:

(If you have forgotten the name, use the CAT function first.)

Once the plan is loaded it is displayed with the same colours, column formats, and windows that applied when it was last saved. Thus the resumption of work is very swift.

S: Save the Plan

To save a plan, first use [CTRL X] to reach the top menu. Then S to initiate a save. You are asked for the file name, which must be 1–8 characters with no period or other invalid characters. Alternatively, to save with the same name as when loaded, just reply [ENTER] only.

If a file of that name already exists on the disc then this gets renamed with a .BAK suffix and any earlier like .BAK file gets erased.

The target disc must be pre-formatted, in either data or CP/M format. Files may co-habit with MASTERCALC program – provided file names do not clash with program component names (MC128nnn.BIN). MASTERCALC files automatically acquire a ".BIN" suffix.

Standard BASIC or CP/M procedure must be used to rename a .BAK version of a file back to a .BIN file before this can be loaded by MASTERCALC.

On completion of the save, the plan display is resumed.

C: Catalogue

This simply performs a CAT(-alogue). If tape is selected, use [ESC] to terminate. Use [ENTER] to resume the top menu.

R: Resume current plan

As long as a plan has been loaded or created, this option returns to the display of the plan.

T: Select Tape

This is an inheritance from CPC464 version of MASTERCALC, and behaves like ITAPE. Any subsequent load or save will address the tape interface.

D: Select disc/drive

This is used to cancel TAPE selection, or to select a different disc drive A/B. Press [ENTER] for no change of drive, else A or B. The selected drive is used for subsequent load/save/CAT functions.

***: Alter Colours**

This allows you to alter the colours used for the background "paper",the pen "ink", and the border. We use the word "Ink" here to mean "Pen" in CPC terms. The prompt is:

COLOURS: Paper/Ink/Border

Just touch keys P/I/B to effect the change. Holding these keys will cycle through all 27 shades. Use any other key to resume the top menu with the new colours in force. When a plan is saved it remembers its colour scheme so that upon re-load it resumes this scheme.

X: Exit to Basic

MASTERCALC loader, which is a very short BASIC program called MC128.BAS, uses CALL in its line 100 to give control to MASTERCALC's machine code. Using X at the top menu "completes" the CALL so giving control to whatever line follows 100. Unless you have written an extended loader with User Basic (q.v.) then all X will do is list the Basic and stop. To resume the top menu and leave the current plan intact:

GOTO 100 [ENTER]

If you RUN instead, the current plan will be lost.

SUMMARY OF DISPLAY OPTIONS

While a plan is displayed there are many options available. We have made it very easy to enter data. In essence all you do is use the cursor direction keys to steer to a target cell, then enter your numeric data directly, terminating each value with [ENTER]. To move the window around the plan, use [SHIFT] with the direction keys. To enter text, position the cursor at the target cell and press [SHIFT 2] which is the double-quote symbol,

then key text right across the window if required, ending with [ENTER]. Most of the time, these control functions are all you need to build and maintain your spread-sheet.

MASTERCALC offers many more functions however. Usually, the legend "CTRL K for Menu" can be seen near the bottom of the screen. This is a reminder that using [CTRL K] you can view a summary of the main options. This summary is a memory jogger only, and it is not necessary to view this large menu in order to use the functions listed. The list is as follows, divided loosely into single-key functions and [CTRL key] functions:

```
          Main MASTERCALC 128 Options

Single-key...                  CTRL and key...

C..get column                  A..alter size/format
F..use formula                 B..recalc. direction
H..home in window              C..recalculate
L..left in window              D..toggle auto cursor down
M..change mode                 F..formula options
O..overlay at column           G..graphic histogram
R..get row                     H..home in plan
S..window (un-)split           K..show this menu
T..define total                P..to printer/disc
W..window select               R..toggle auto cursor across
< or >..nudge cell text        S..show spare bytes
&..repeat entered value        T..show total/formulae usage
↑..top of window               X..Top menu, save/load etc
"..enter text                  Z..clear row/column/cell
(+-)number..enter value        @..screen copy to Epson etc

↑↓←→..move cursor              SHIFT ↑↓←→..move window
```

[figure 9]

Some in the "single-key" list require use of [SHIFT] too, but it is convenient to show the list in this way.

Certain functions in turn yield further options, for example [CTRL A] which invites a variety of size/format changes.

CURSOR MOVEMENT

The cursor direction arrow keys move the cell cursor around the current window, but when the window edge is reached no further movement takes place.

A quick way to the left-most edge of the window is L.
A quick way to the top-most row of the window is ↑ (unshifted £ key).
A quick way to the top-left of the window is H.

When entering several values across a row or down a column, it is best to set auto-cursor-advance, using [CTRL R] or [CTRL D] respectively. An arrow symbol at bottom left of the screen indicates which, if any, is currently enabled. With auto-advance, pressing [ENTER] either by itself or upon entering data will shift the cursor ready to enter data into the next cell. However, there is no movement beyond the edge of the current window.

WINDOW MOVEMENT

To move the window, use [SHIFT] and a cursor arrow key. Note that the moved window retains the left-most column and top two rows, on the assumption that they contain text to identify the spread-sheet data.

[SHIFT arrow] generally moves the window so as to resume where the previous window left off. But to position the window starting at a specific row or column, use R or C instead. In either case, you are asked for the target row or column number.

If [SHIFT arrow] is repeated before the window completes the re-paint, then the re-paint is abandoned and the shift made almost immediately. But beware doing this if the edge of the plan is met, as painting will halt but then no movement takes place!

To move the window to the "home" position at top left of the plan, use [CTRL H]. Now for some clever stuff ...

You can "fold" the plan along a vertical line so that one can view columns which would not normally be visible in the same window. This is done using the letter Oh key. ("O" for "Overlay".) For example, if you have columns 1–9 in view but wish to see column 20 where column 6 is, move the cursor to column 6 then press O (the letter, not zero) then 20 [ENTER]. The window is then re-drawn showing columns 1, 2, 3, 4, 5, 20, 21, etc., with columns 6 to 19 hidden.

The overlay function is useful for keeping a total column in view whilst you work on other columns. Another use is to exclude column 1 from the window, perhaps in preparation to drawing a histogram. (q.v.) It is also possible to have the same column twice in the same window, using this overlay method. Indeed, if one works from left to right, one can list any columns in any order. This order is preserved even when moving the window vertically, but normal order resumes once you move the window horizontally.

WINDOW SPLIT

Option S will split the screen horizontally into two windows which may then be shifted quite independently of each other. There is a toggle action such that a single large window is resumed if S is used again.

Only one window is "active" at a time, this being the one which shows the cell cursor. Key W (for Window) acts as a toggle to select one or other windows. Re-selecting a window "remembers" where its cursor was.

Split windows are most useful in that they enable part of the plan (e.g. the grand totals) to be kept in view whilst the other window can be used to move about the plan to make changes. Another advantage is that window re-paint is faster in a split screen than in a full screen.

[Re-paint involves translation of all displayed cells from internal floating point binary to ASCII characters, a heavy workload and also CPC screen writing is not very fast.]

It is possible to have the same data in both windows, but note that if one version is altered, the other remains unchanged until a re-paint is caused. This is deliberate to save time, and also to give the user the chance to compare before and after states.

MODE CHANGE

Normal mode is 2, i.e. 80-column mode. But using M one can toggle the main display between mode 1 (40-column) and mode 2. Mode 1 is only likely to have value for colour monitor users.

ENTERING NUMERIC DATA

Numeric data is keyed directly, with no preamble. An immediate edit line is created within which [DEL] and cursor left/right keys are recognised. Upon [ENTER] the edit line is cleared and the numeric value is transferred to the current cell and displayed according to the format of that column.

If the current cell already contains text or a computed value, then direct numeric entry is forbidden and the message appears:

Cell contents conflict . . . ENTER

To over-ride this protection, you must first use [CTRL Z] etc. to clear the cell.

ENTERING TEXT

Text can be written into any cell which has no number stored or computed. To signal that text is to be stored, use [SHIFT 2] which is the double quote key. This initial double quote does not form part of the text; it is used just to indicate that text is to follow, and the legend appears:

Enter text at cursor

Subsequent text is echoed directly in the target cell, shrinking the cell cursor as the text is keyed. Text is allowed to cross cell boundaries in a continuous manner, but cannot go beyond the window right edge. Neither can text cross into a numeric cell. [DEL] is recognised in the usual sense of destructive backspace, but is limited in scope to the current cell.

To terminate text entry, [ENTER] must be used – even if the window edge has been reached. Only when the "Enter text at cursor" message vanishes will the program respond to other commands.

When entering text into a wide cell (greater than eight characters) then extra RAM is consumed. For near-capacity plans this can result in a failure due to lack of space, thereby truncating the last piece of text.

ADJUSTING TEXT

It is often desirable to shift a column heading right or left a small amount for cosmetic reasons. Rather than re-key a piece of text, two special "nudge" keys can be used to shuffle the existing text within a cell. Keys "<" and ">" perform this nudge, left and right respectively. If the current cell is not a text cell, pressing these keys has no effect.

An occasion when this is of particular use is after altering the display width of a column. Note that narrowing a column or nudging the text to the right does not lose the text, as widening or nudging left again will retrieve the hidden part.

REPEATING VALUES

The system remembers the last entered value, which can therefore be repeated at any other suitable cell. This saves time when keying a row or column of identical values such as overhead costs. Use [SHIFT 6] to reproduce the last-entered value. If you also set auto-advance on, just holding down [SHIFT 6] will repeat all the way to the window edge.

There is no auto-repeat for formulae or totals; but by programming a function key in the loader Basic, even these can be effected. For example, suppose we wish to store Formula 2 in each cell down a column. We can program the f9 key for example, as follows:

a) **At top menu press X to exit to Basic**

b) **KEY 137, "F2"+CHR$(13): KEY DEF 3, 1 [ENTER]**

c) **GOTO 100 [ENTER]**

Now R to resume the plan, set auto-advance to down, steer the cursor to the top of the target column, and simply hold down the f9 key.

Step b) above requires that you research the CPC Manual in respect of KEY, KEY DEF, token values, and key numbers. If you have not done this kind of thing before, have a play with straight Basic, without MASTERCALC loaded. These manipulations are powerful time-savers and are well worth learning even if you never use the rest of CPC Basic. And you will find many applications besides MASTERCALC where they can be put to good use.

CLEARING DATA

To reset one or more cells to the empty state, for example in order to be able to re-use a numeric cell for text, use [CTRL Z]. This gives the choice:

CLEAR: Row/Column/Entry

Reply R to clear the entire row, or C to clear the entire column, where the cursor is. Or use E to clear just the current cell. Clearing a row or column is complete, and not restricted to the window view.

SPARE MEMORY SPACE

With 64K to play with, you have room for over 7000 cells, plenty text, and many formulae. [CTRL S] tells you exactly how many spare bytes are left for expansion. It responds with:

Spare bytes = nnnnn

Any overflow attempt yields a BEEP and the message:

No more room – ENTER

INSERTING/ERASING A ROW OR COLUMN

You need not worry about predicting accurately the dimensions of your spread-sheet, since it is possible to insert or erase rows or columns at any time. Of course you may find that some formulae need to be amended since any rows or columns after the insert/erase point will be renumbered.

Start by using [CTRL A], and then Y in response to:

ALTER: array size Y/N

The next prompt asks:

Insert/Erase

Press I or E accordingly. The next prompt asks:

Row/Column

Press R or C accordingly. The next prompt asks:

Number:

For an erasure, give the number of the row or column to be erased.

For an insertion, give the number of the new row or column. For example, to insert a new row between rows 4 and 5, reply 5. When a new column is inserted, the format of the preceding column is used, but inserted rows or columns are always set empty.

It is not possible to insert a new row 1 or column 1. If there is insufficient room to extend the array, the message is:

No more room – ENTER (BEEP)

ALTERING COLUMN FORMATS

When a plan is first created, column 1 display width is 12 and the other columns are set to 8 characters. All columns assume integer format and no thousands commas. But MASTERCALC lets you tailor any columns individually or in ranges, in respect of:

a) **Display width: 4 to 24 characters**

b) **Decimal places: 0 (integer) to 7**

c) **Thousands commas: Yes or No**

Because MASTERCALC always stores data to the highest precision, altering formats after data is stored does not cause any loss of data precision.

To make a change in format, start with [CTRL A] and then N. You see:

Width/Dec pl/Commas/Title

Reply with W or D or C (T is covered later) and then you are asked for the range of columns to be affected:

From column . . . :

Reply with first column to be altered, then

. . . To column:

Reply with last column (same as previous reply if just one column). Finally, respond to one of these prompts:

Width (4–24):
Dec. places (0–7):
Commas (Y/N)

Which prompt you get depends on your earlier response. The change of format is then made and the screen re-drawn reflecting the new style.

SUPPLYING A TITLE

A title of up to 40 characters can be displayed at the top of the screen, to the right of the file name. The default title is the name of the program, but you can over-write this starting with [CTRL A] then N. Then T in response to:

Width/Dec pl/Commas/Title

You are then asked:

Give plan title:

Key up to 40 characters of text; if you key more, the excess will be ignored. Complete this with [ENTER] whereupon the screen is re-drawn showing the new title.

COMPUTED DATA: TOTALS

Any cell can hold a value computed from other data in the plan. A common requirement is to make a total of a row or column. With MASTERCALC all you need do is steer the cursor to where a total is needed and press T. This yields the prompt:

TOTAL: Row/Column/Accum

Reply with R or C for a row or column total respectively. Then you are asked:

Sub-total/Full total

Reply F for a full total, or S for a sub-total.

For a full row total, the program scans all cells to the left in the same row and adds together all values except other row totals, and the result is placed in the current cell. For a sub-total, the scan stops short of any other row total.

For a full column total, the program scans all cells above in the same column and adds together all values except other column totals, and the result is placed in the current cell. For a sub-total, the scan stops short of any other column total.

Totals are calculated and displayed immediately when T is used, but in the event of changes to the component values, there is no automatic recalculation until [CTRL C] is used.

A variation of direct total is the Accumulator via T A. This simply sums the cell to the left with the cell above and stores the result at the cursor. Thus a chain of TA cells either across or down will maintain a cumulative sum.

COMPUTED DATA: FORMULAE

A formula is an expression used to compute a value. MASTERCALC allows up to 99 formulae. An example of a formula is:

R5C12 * 1.15

This means "the value in row 5 column 12, multiplied by 1.15". Thus R5C12 refers to a cell, the star means "times", and 1.15 is a literal number.

Cell references begin with r or R or c or C. The cell reference "c2R5" is the same as "r5c2".

A formula can contain any number of cell references, numbers, operators, and brackets, subject to an overall maximum length of 75 characters. Operators recognised are, in precedence order:

*	times
/	divide
+	plus
–	minus
<	less than
>	greater than

The precedence of operators is such that * and / are generally done before + and –, and these before < and >. Therefore the expression:

3 + 4 * 5

evaluates as 23, rather than 35, since the * is done before the +. If we wish the + to operate first, we would use brackets to change the precedence as follows:

(3 + 4) * 5

This would yield the result of 35.

Use brackets to change precedence or to make it clearer. Spaces can be embedded anywhere except within a cell reference. Only round brackets may be used. Nesting is allowed to any level.

Portability

Suppose a formula is needed to compute in column 3 the difference between row 10 and row 5, in the same column. The formula could be:

R10C3 – R5C3

Now suppose a similar calculation is required in column 4, and in column 5, and so on. We could create a second formula for use in column 4 as follows:

R10C4 – R5C4

Instead, the same PORTABLE formula can be used in EACH column, thus:

R10 – R5

The two cell references are now partial in that whilst row is specified, column is not. The column is therefore taken to be the same as where the formula is used.

Similarly, a cell reference such as "C12" would take the missing row number from wherever the formula is used.

Relative Cell Reference

Another aid to portability is to specify cells not in absolute terms but relative to the point of use, i.e. a fixed number of cells away in either or both directions. The notation is simply + or – a number immediately after R or C, for example:

(R–1)	"the cell above"
(c+3)	"the cell three to the right"
(r–1c–2)	"the cell 1 up, 2 to the left"

The brackets are not essential but are advised for clarity.

Example of use: to show compound interest of 8% along a row, we simply show the principle sum in one cell and then use the following formula in cells to the right:

(c–1) * 1.08 "previous column times 1.08"

Another example is a bank statement: suppose each line (row) has withdrawals in column 3, deposits in column 4, and a running balance in column 5. We would use the following formula down column 5:

(r–1)+c4–c3 "prev balance + deposit – withdrawal"

As a general rule, try to ensure all your formulae are portable.

Conditional Terms

There are some applications where a value is to be computed only where a condition is met, such as a cell value being over a certain threshold. An example is a tax computation where different tax rates apply to each income band. In MASTERCALC formulae we can use operators < and > to test a value.

Thus for example, the term: (R4 < 1000) evaluates to 1 if true, 0 if untrue. Hence if cell R4 contains 300, the term evaluates as 1.

Suppose that we wish to compute sales commission as 10% of sales value but only on sales above 6000. If sales value is in column 2 then the formula for commission would be:

0.1 * (c2 > 6000) * (c2 – 6000)

The conditional term (c2 > 6000) equates to 1 only if c2 exceeds 6000, and is zero otherwise. This keeps the commission at 0 until sales exceed the stated threshold of 6000. Without the conditional term, low sales would yield a negative commission, not very nice for the unlucky salesman.

Creating a Formula

Use display option [CTRL F]. It does not matter where the cursor is, but it is clearer to first steer the cursor away from a formula cell. The prompt comes up:

FORMULA: New/Amend/Erase/Print

Use N to indicate a new formula is to be made. Then you are asked:

Formula number 1–99:

Reply with any suitable number in the range 1 to 99. It is tidiest to start at 1, but not essential. The formula number is used to associate one or more cells with this formula. Now you are asked:

Enter new formula ...

Key the formula, up to 75 characters. [DEL] and [CLR] work as usual, and so do cursor left- and right-arrow keys. There is no insert mode, except that cursor up-arrow will insert a space. Use [ENTER] to signal completion. MASTERCALC immediately validates the formula in terms of balanced brackets and cell references within range. If it finds an error then it leaves it in the edit area to be amended.

It is possible that a formula may look invalid until used, in which case use [ESC] to force the program to accept it. For the purpose of validation, all cell references are considered to evaluate to 1 so it is possible to get a zero-divide overflow here which would not occur when in use.

Altering and Erasing a Formula

Use [CTRL F] then A for alter or E for erase. You will be prompted for the formula number.

Option A to alter will present the formula for editing, while Option E erases it. Altering a formula does not automatically cause any computed values to be revised. This will typically happen only via [CTRL C].

To display a formula without altering it: Use [CTRL F] then A as if to alter, but use [ESC] when the formula is displayed. Alternatively, steer the cursor to a cell where the formula is used, and press [CTRL F] which automatically displays the formula.

To Print all the Formulae

Use [CTRL F] then P. All the formulae are listed on the printer, in ascending formula number. If you select this function and have no printer connected and ready then you can escape using [ESC].

How to Use a Formula

We have kept the easy bit until last. Just steer the cursor to the cell where the computed result is needed, and press F followed by the number as prompted, then [ENTER]. The calculated value is displayed instantly.

You can use the same formula in any number of cells, without any extra RAM overhead.

Warnings:

a) MASTERCALC will recalculate row by row, or column by column. It is important to take this into account where formulae make references to cells which are in turn computed.

b) The program regards it as an error if a cell uses a formula which refers to the same cell, since this would be an unstable situation where successive recalculations would give differing results. An exception to this rule is allowed where a cell is referred to via (r–0) or (c–0), but then great care must be taken with use of [CTRL C].

HOW TO SEE WHICH CELLS ARE COMPUTED

Normally, your plan displays only text and numeric values. But you may need to remind yourself which values are direct and which are computed, and how they are computed. [CTRL T] achieves this by showing each computed cell in the window high-lighted with the legends:

RT	for a row total
RST	for a row sub-total
CT	for a column total
CST	for a column sub-total
CUM	for a cumulative total
Fnn	where nn is the number of the formula used

Press any key to proceed.

GRAPHIC HISTOGRAM

The easiest way to see whether profits are up or down, or what the trend is, or how sales respond to advertising, is to draw a picture. MASTERCALC can plot one, two, or three rows at a time, in histogram form. Start with [CTRL G] which clears the lower half of the screen and then you are asked:

GRAPH: give 1st row to plot

Reply by giving the row number to be plotted. Then:

Give 2nd row, if any

Reply again with a row number, or just [ENTER]. Then:

Give 3rd row, if any

Reply with another row number, if required.

That is all there is to do, as MASTERCALC swiftly draws the histogram, showing one set of bars for each column in the current window. The first row is plotted as solid, the second as outline, the third in a stippled effect. The chart is automatically drawn to scale to accommodate the highest and lowest values plotted. If the lowest value is above zero, then zero is taken as the low value. Any negative values cause the base line to be drawn higher to accommodate downward bars.

For each row plotted, a key is given, annotated by taking whatever text is present in column 1 of that row. Since column 1 is normally a descriptive label, this is usually appropriate.

The program waits for a decision about any further chart as follows:

Another ? Y/N

Reply with Y or N accordingly. The reply N restores the screen to its previous state before [CTRL G] was used.

The histogram bars are geared to the columns displayed in the current window, so by reducing the column widths one can increase the span of columns plotted.

If you draw a graph then shift the window and draw another graph of the same variables, the vertical scales are not likely to be the same since this scale is adjusted dynamically to the range of values on display.

The rows being plotted need not be shown in the current window.

TEXT OUTPUT

The spread-sheet data can be printed to paper – it can also be sent as a series of line images to disc or tape for later use by a word processor such as TASWORD or PROTEXT. To initiate text output, use [CTRL P] which yields the prompt:

TEXT OUTPUT: Printer/Disc

We will discuss option P first. Assuming that you now press P:

Row/column numbers to be included Y/N

The row and column numbers can be printed or not, reply Y or N. Next, MASTERCALC gives you the chance to send control codes to your printer (which should therefore be switched on and ready before you give any further replies):

Printer control code in decimal, if required:

Press [ENTER] if you do not wish to send any. Otherwise, send as many as you like, each terminated with [ENTER]. Each code must be decimal and in the range 1 to 127, and we refer you to your printer manual to find which codes are suitable. But a useful combination to EPSON-compatible printers is:

14 [ENTER] 15 [ENTER] [ENTER]

This programs a double-width heading line and condensed mode for the rest of the output. On many printers this allows 132 characters per line. Next you are asked:

Number of characters per line or [ENTER] if 80:

Reply any number from 40 to 240, or just [ENTER] by itself to signal the default of 80 characters per line. If you sent condensed mode code earlier then perhaps a value of 132 here will be suitable. Finally:

Stop after row or [ENTER] if to last row:

[ENTER] by itself signifies that the printing will stop after the last row has printed. Otherwise, give the last row to be printed.

MASTERCALC then prints according to the following rules:

a) **Rows 1 and 2 are always printed.**

b) **The next row printed is the third row shown in the current window.**

c) **Further rows follow, until either the last or the "stop after" row printed.**

d) **The first two array columns printed are those in the current window.**

e) **Further columns follow sequentially to the right, limited by the stated paper width. A column is not shown at all unless there is room for its full width.**

Note that for wide plans, a full print must be done in stages, each stage starting by positioning the window to indicate the start array column. If you wish to file the sheets as separate pages then you probably want column 1 repeated on each page. The default window movement keeps column 1 in view so this is easy. Conversely, you may wish to tape the pages side by side and so column 1 repeat is not wanted. In the latter case, use display options L O in order to force a window to omit column 1.

For deep plans you can print continuously – crossing the perforation lines regardlessly. Alternatively, you can print separate pages vertically by giving a "stop-after" row number. Title and rows 1 and 2 are always printed, irrespective of the window position.

If you make several print runs, then there will be no need to repeat all the printer codes — except for those such as 14 which the printer forgets about after one line. If you have just made a hi-res print via [CTRL Ø] then it is advisable to turn the printer off then on again before text printing.

To abandon a print run, unready the printer and press [ESC]. If you select text print with no printer attached, [ESC] will rescue you.

Text to Disc

If you wish to send the print text image to disc instead of to the printer, for example for later word-processing, then use [CTRL P] and then reply D for Disc.

You are then asked to give the name of the file to be created. Further prompts are as for printer output, except that no control codes are asked for.

The disc drive used will be whatever is currently selected, or indeed one can also write to tape instead. Use the top menu to select tape/disc/drive as required beforehand, if necessary.

HI-RESOLUTION SCREEN COPY

MASTERCALC will send a hi-resolution screen dump to an EPSON-compatible printer if requested via [CTRL Ø]. Control zero is recognised at any time when the program would respond to a single-key option. This means any time except when reading text from the keyboard. For example, after a graphic histogram has been drawn and the prompt is Another Y/N then MASTERCALC will respond not only to Y and N but also to [CTRL Ø].

The response to [CTRL Ø] may not seem immediate, since it takes a few moments to gather enough dots from the screen to send to the printer, and the full screen copy can take a minute or more, depending on which printer you have.

[ESC] may be used to abort the screen dump

The process drives the printer in graphic mode and sets its feed rate to 7/72". On some printers the correct setting is 6/72" to avoid thin gaps between pixel bands — see disc documentation for a possible fix.

If you have wide gaps between pixel bands and also text print is double-line spaced, then you will need to patch MASTERCALC to suppress its LF codes to the printer. See disc documentation for details.

The figures in this manual were produced simply using [CTRL Ø].

RECALCULATION OF COMPUTED VALUES

When T or F functions are used, the computed value is shown at once. But when the source data is altered there is no automatic recalculation of dependent cells. The reason is that this would slow down the data re-entry process. Recalculation is therefore done on demand only, via [CTRL C].

Recalculation is done throughout the plan, and whilst this is happening the legend appears:

— — — Calculating — — —

This can be anything from a fraction of a second to over a minute, depending on how many cells are involved, how complex the formulae, and especially how much non-integer division is done.

On completion, the current window is refreshed cell by cell. If the screen is split then the non-current window is left unaltered until it is moved or re-drawn for any reason. This is deliberate not so much to save time, but more to allow you to compare before and after values by setting both windows to the same part of the plan.

Order of Calculation

MASTERCALC can calculate either by row or by column. It may be that your plan is not sensitive to the direction used, but if formulae use other computed cells then it is important to select the appropriate direction to give correct results. To see what direction is currently assumed, use [CTRL B]. This produces:

Calculation is by row / . [SPACE] to change, else any key column column

Use the SPACE bar to flip to the other direction if required, or use any other key to leave the direction unchanged.

When a plan is saved, its direction is saved with it so that on re-load any further recalculation will be in the correct direction for that plan.

It is possible that in a complex plan one may need to recalculate once or more in each direction before the end results stabilise.

NUMERIC OVERFLOW

There are several kinds of overflow condition, some more serious than others.

The first kind is one of display room: there is no forced gap between columns so large values can touch the cell to the left, which can look untidy. Ideally, it is best to arrange column widths to be at least 1 wider than the longest data it contains. If a value will not fit then it is truncated at the left and the left-most digit is shown in reversed colours to high-light the condition. No data is lost, it is merely invisible. Text output will not warn of such overflow.

If a value is greater than 9999999999999999 (sixteen nines) then it is deemed to be erroneously large and is shown simply as "*". Note that it is impossible to enter such a value directly, so such overflows can only happen with computed data.

The internal numeric format allows much larger values, up to about 10 to the power of 38. Any "*" values are below this internal maximum and may be used correctly within formulae.

If a value would overflow the internal maximum then MASTERCALC warns with a BEEP sound and the value is stored as zero. If this happens during a recalculation the row and column of the offending cell are shown viz:

Error in row xxx col yyy [ENTER]

The commonest cause of "hard" overflow is division by zero, perhaps processing a formula when cells referred to have not yet had data stored in them.

When a formula is entered or altered, via [CTRL F] etc., then any cell reference is deemed to evaluate to 1 for the purpose of validation of the formula. This prevents zero-divide overflow in the event that values to be used have not yet been stored in the plan.

VERY SMALL NUMBERS

Due to rounding, values greater than zero may show as 0. There is no way to differentiate between these and genuine zero values, but small numbers will still operate correctly within formulae and totals.

The smallest number above zero which can be shown is 0.0000001 since the maximum number of decimal places is 7.

The smallest number above zero which can be held internally is about 10 to the minus 38.

NEGATIVE NUMBERS

These show a minus sign to the left. The absolute range is the same as for positive numbers, but extra display width is needed to accommodate the sign.

APPARENT ARITHMETIC DISCREPANCIES

Because MASTERCALC always rounds values at edit time only, it is very accurate in computation. However, a side-effect may be an apparent lapse in precision, as the following example shows:

The values 1.3 and 3.4 will appear as 1 and 3 respectively when shown as integers. But their total (4.7) will show as 5. Thus the plan would appear to show that 1 + 3 = 5.

This effect will sometimes cause a difference in £0.01 in the balance total of an account where computation (e.g. of VAT) has created internal amounts of fractions of a penny. Sorry, there is no easy solution to this problem unless one elects to write computations in User Basic and force intermediate results to be rounded.

PROGRAM BACK-UP AND FILE TRANSFER

You should consider taking a back-up copy of MASTERCALC for security, and we suggest the use of the CP/M utilities provided with your CPC system.

TAKING A BACK-UP COPY FOR YOUR OWN SECURITY IS PERMITTED. YOU ARE REMINDED THAT TRANSFER OF ANY COPY OF THE PROGRAM OR MANUAL TO A THIRD PARTY WHETHER FOR SALE OR OTHERWISE IS A BREACH OF COPYRIGHT, IF DONE SO WITHOUT THE WRITTEN CONSENT OF CAMPBELL SYSTEMS.

Your files can be transferred to other discs using either MASTERCALC or CP/M utilities.

A good scheme is to keep a working copy of the program on the same disc as the application file(s). This avoids a disc change on start-up. Periodically, take a full disc copy onto a back-up disc, if you make frequent up-dates to the files.

USER BASIC

For those people who need to do special things to their spread-sheet data, we have provided access in Basic cell-by-cell. Thus with a small knowledge of Basic you can extend the MF128 Basic loader program and pass data to/from any cell. Although the cell values are in floating-point binary, all data is passed as ASCI strings. Using BASIC therefore one can perform higher math functions such as SIN and LOG which MASTERCALC cannot handle directly.

The loader program, MC128.BAS is very brief and is along the lines of:

```
 10 MC=&6000:GETC=&6002:PUTC=&6005:ind$=" "
 20 MEMORY &27FF
 30 LOAD "MC128AR",&3000:LOAD "MC128MC",MC
 40 INK 0,23:INK 1,0:BORDER 23:PAPER 0:PEN 1
100 CALL MC
110 MODE 2:LIST
```

The top menu offers [X] to return to Basic, which therefore gives control to line 110. Our line 110 just lists the Basic, but you may remove this and insert any Basic you wish beyond line 100. You can customise any number of different loader programs, each with their own User Basic to process your spread-sheet data.

Line 10 defines two User Basic entry points to the machine code. Thus GETC is used to access a cell and PUTC is used to store into a cell.

To access a cell:

```
n$=SPACE$(24)
CALL GETC,row,column,@n$,@ind$
```

"row" and "column" may be absolute numbers or any numeric expression. The third parameter passed is the address of a string of at least 24 characters long to receive the data. The last parameter is the address of a return code which is set on return to one of:

"V" indicating a numeric value has been retrieved
"T" text has been retrieved
"E" error, e.g. row or column zero or out of range

If a value is retrieved, it is automatically formatted to seven decimal places.

Similarly, to store data into a cell:

CALL PUTC,row,column,@x$,@ind$

"row" and "column" are passed the same as for GETC. The last parameter is similar to that for GETC except that it is returned "E" for error, blank otherwise. The third parameter is the address of a string of any length containing the data to be stored.

PUTC examines the passed string, and if it looks numeric then the target cell is stored as a direct value cell. If the cell had been text or computed data before, such designation is forgotten. If the passed string does not look numeric, then it is stored directly as text up to a limit of eight characters.

Here is an example: suppose we wish to store column 5 by taking column 4 and multiplying by 2. We wish to do this from row 3 to row 20. We could of course use a formula, but here is how to do it in User Basic:

```
200 n$=SPACE$(24)              'set n$ to receive from cell
210 FOR row = 3 TO 20          'control which rows
220 CALL GETC,row,4,@n$,@ind$  'column 4 of the row into n$
230 x$=STR$(2*VAL(n$))         'compute new string value
240 CALL PUTC,row,5,@x$,@ind$  'store into column 5
250 NEXT row
260 GOTO 100                   'resume MASTERCALC top menu
```

In our example we did not bother to test the return code in ind$, but for debugging purposes perhaps one would STOP if the value of "E" is returned. We also assumed that only numeric data would be retrieved. If text is found in column 4 then line 230 simply creates a string of "0".

The scope of User Basic in MC128 is limited only by the user's knowledge of Basic and about 10K of RAM. (Our example above would need only about 300 bytes of RAM.)

One can "export" data cell by cell to another program for further processing, for example a graphics package, or to a database such as MASTERFILE 128. Similarly one can "import" data from some other computer source.

FILE STRUCTURE

It is not necessary for you to know how MASTERCALC stores your data, and you can skip this chapter. For those who are interested here are some notes.

The program lives in the primary RAM, and comprises Basic loader and two machine-code components. The entire 64K secondary RAM is dedicated to the plan file. At any one time, the second 16K of Z80 address space holds either a 16K quadrant of the file, or part of the program in the primary RAM. Intelligent memory bank switching looks after this.

The file itself consists of:

a) Preamble, contains filename/window pos/colour/etc.
b) The main array, 9 bytes per cell
c) Column formats, 2 bytes per column
d) Text overflows, each identified by cell row and column
e) Formulae, in any order, each identified by number 1–99

The 9-byte cells comprise 1 byte class code and 8 bytes of data. The data is either text, or a binary floating point number of 1 byte exponent and 7 byte mantissa. The class code defines the data as being one of:

Unused
Direct keyed value
Cumulative value
Row total
Row sub-total
Column total
Column sub-total
Text (up to 8 characters)
Text (8 characters, linked to text overflow)
Formula number used to compute the value

The column formats describe the display column width, the decimal places, and thousands commas. The presence of these bytes explains why a 10 x 200 array is a different size from a 200 x 10 array.

The memory requirements of a plan depend not only on the number of cells, but also the number of columns, and the number and length of text overflows and formulae.

Notes

MASTERCALC 128 FEATURES

- Large capacity, room for 7,000 cells. e.g. 100 rows x 70 columns.
- Uses the full 128K RAM of the CPC6128 or extended 464/664.
- All values stored as signed 8-byte floating point.
- Direct totals and sub-totals by row or by column.
- Up to 99 formulae, each allowing complex arithmetic expressions.
- Unique formula portability allowing many cells to share a formula.
- Formulae can have conditional terms.
- Recalculate by row or by column.
- Insert or erase a row or column.
- Text can be keyed directly anywhere on a plan.
- Text in a cell can be "nudged" left or right.
- Numbers can be shown as integer or up to 7 decimal places.
- Numbers can include 000's commas.
- Columns can be tailored individually in respect of width/format.
- Numeric display range is +/− 0.0000001 to 9,999,999,999,999,999.
- Intermediate computation range is approx 10 to the power +/− 38.
- Plan can be "folded" to keep distant columns in simultaneous view.
- Screen can be split horizontally into two independent windows.
- Toggle between 40-column and 80-column mode.
- Auto-cursor advance right or down.
- Repeat-last-value facility.
- Text print with many printer options.
- Text output to disc, for word-processing for example.
- Hi-res screen snapshot for Epson-compatible printers.
- Instant highlight of all computed cells.
- GRAPHIC HISTOGRAM of 1, 2 or 3 rows.
- Colour trim.
- Pop-up menu of the main options.
- Load/save/drive select/CAT options.
- User BASIC option for data manipulation.
- FULLY MACHINE CODED, WITH FAST MEMORY BANK-SWITCHING.
- Detailed manual with illustrated tutorial.

Applications include:

Bank Statement; Sales Analysis; Household Budget; Profit & Loss; Trend Analysis; Project Control and Costing; Financial Forecast.

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